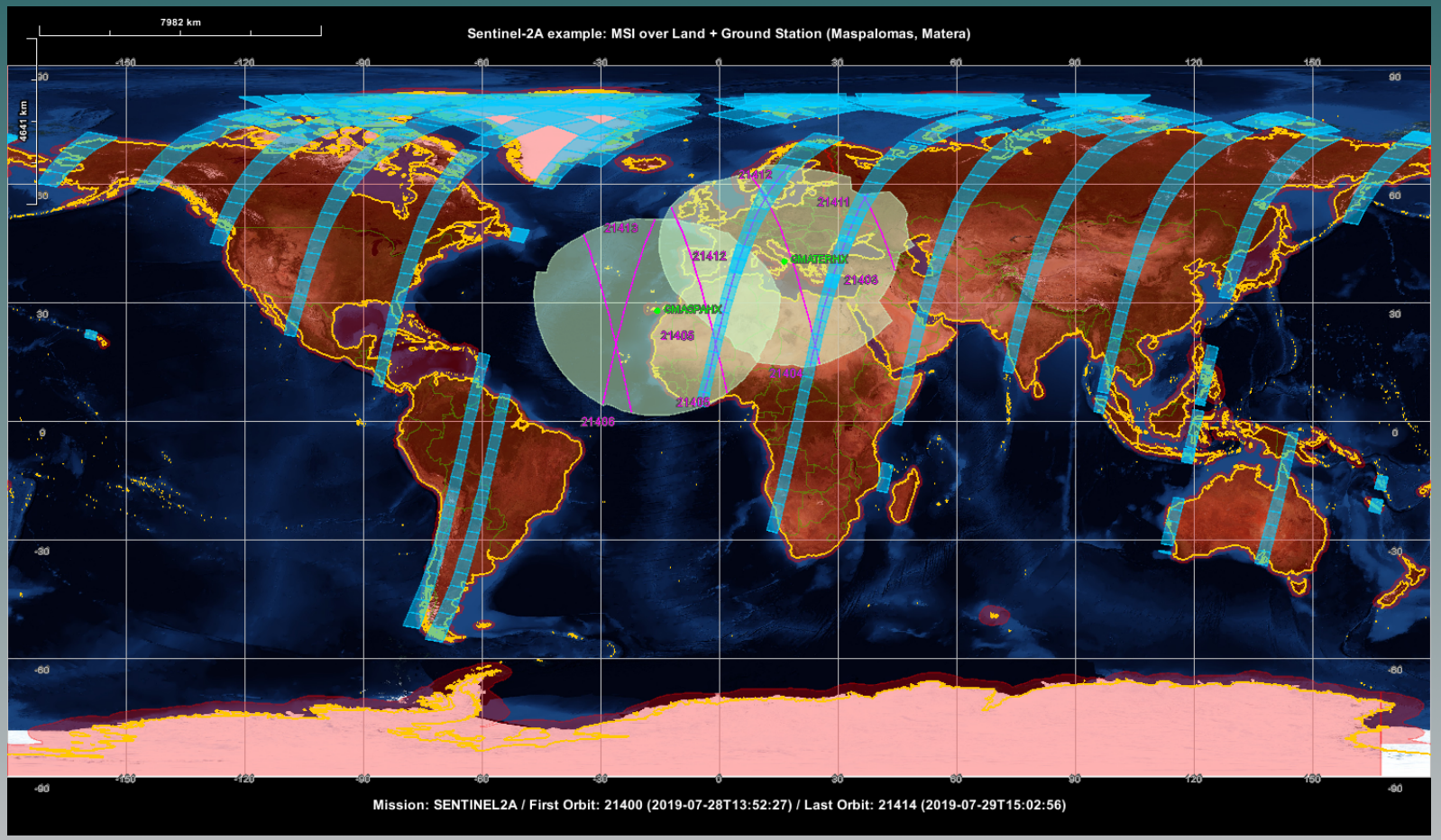
ESOVNG - Getting Started

About input mission files



ESOVNG: Input Mission Files - Overview

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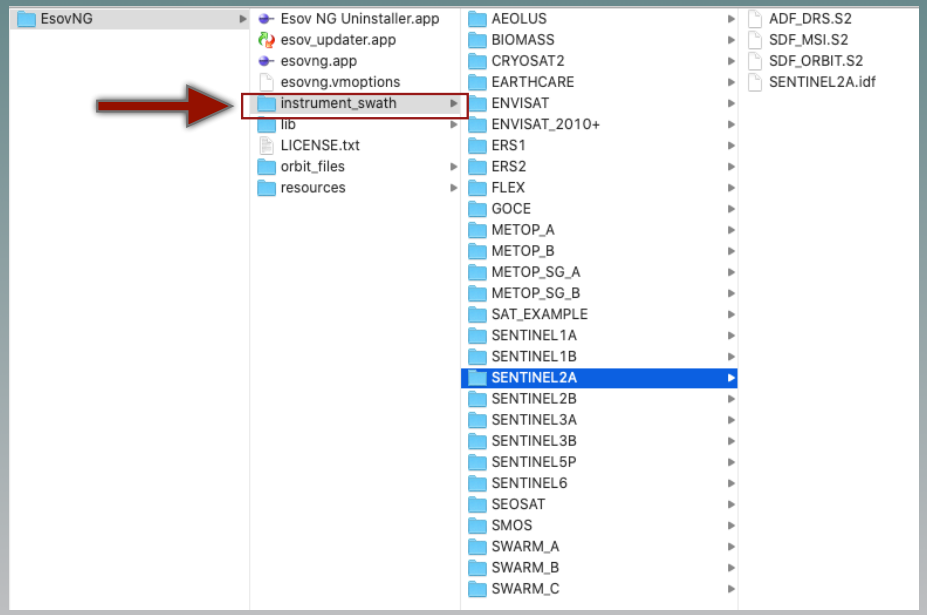
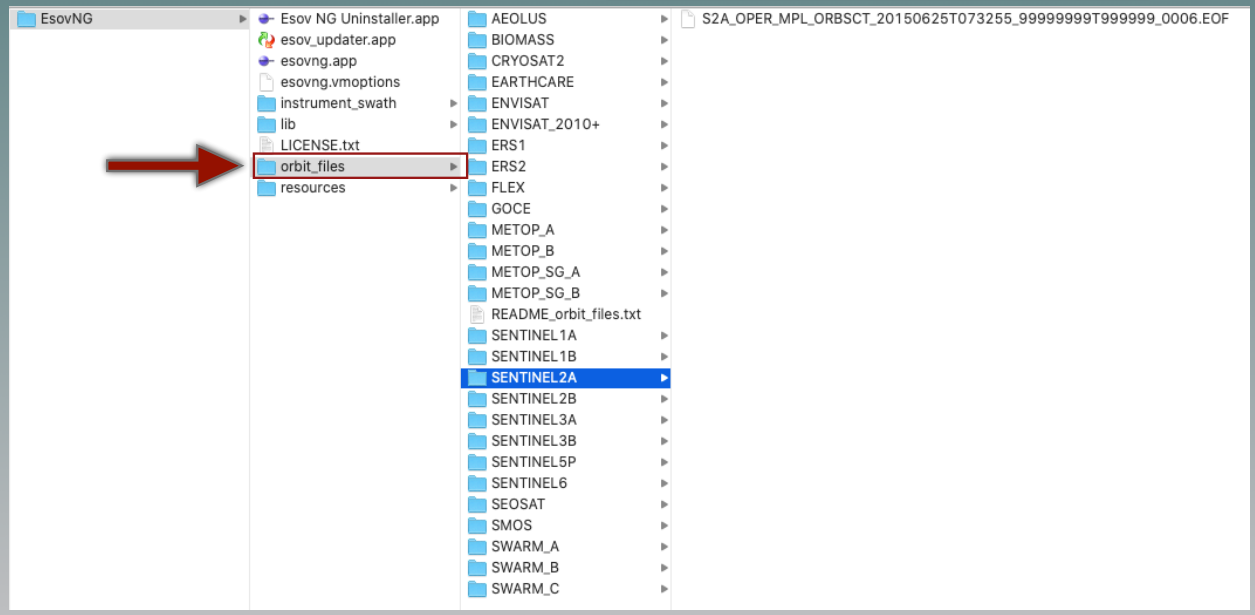
- Each satellite mission makes use of several input files:
  - ✓ Satellite Identification File (.idf), in folder instrument_swath — Specific ESOVNG file format
  - ✓ Orbit File (OSF, POF, ROF, TLE), in folder orbit_files — EOCFI SW file format
  - ✓ Attitude Definition File (optional, only for DRS link enabled missions), in folder instrument_swath — EOCFI SW file format
  - ✓ Instrument Swath Definition Files, in folder instrument_swath — EOCFI SW file format





ESOVNG: Input Mission Files - Satellite Identification Files (I)

Satellite Identification Files (IDF) contain mission definition parameters

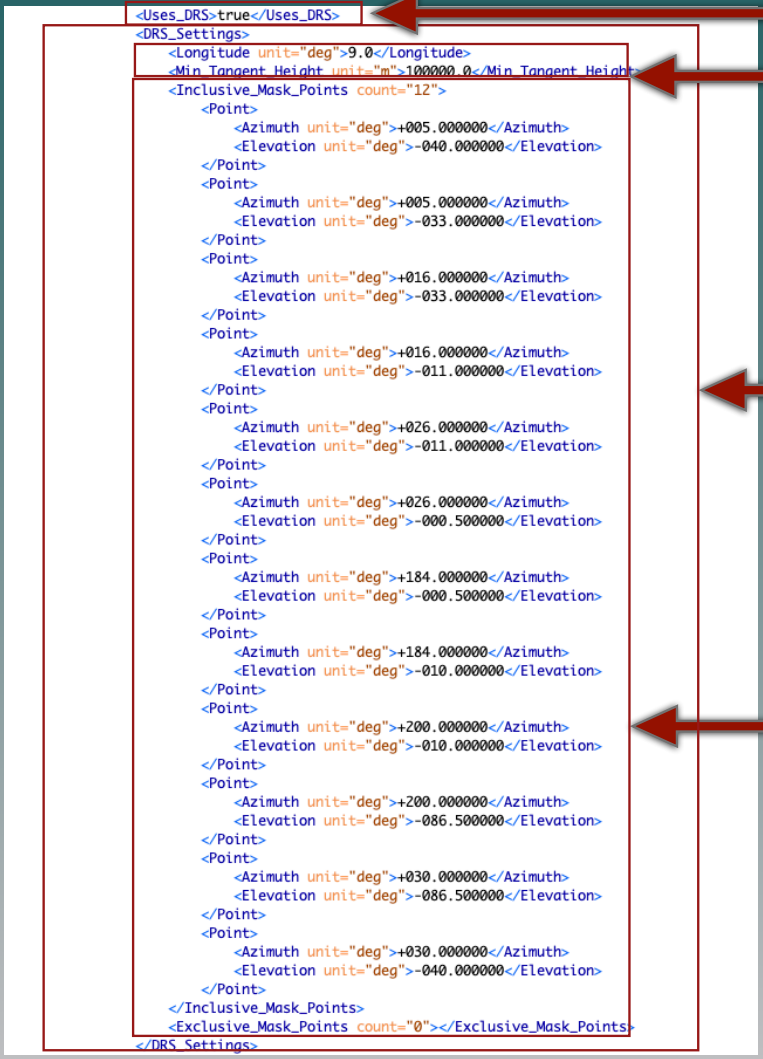
```
<?xml version = "1.0" encoding = "UTF-8"?>
<Earth_Explorer_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://eop-cfi.esa.int/esov http://eop-cfi.esa.int/esov/ESOVNG_SCHEMAS/EO_ESOVNG_IDF_0100.XSD"
   xmlns="http://eop-cfi.esa.int/esov" schemaVersion="1.0">
  <Earth_Explorer_Header>
      <Fixed_Header>
          <File_Name>SENTINEL2A.idf</File_Name>
          <File_Description>Satellite Identification File</File_Description>
          <Notes></Notes>
          <Mission>Sentinel-2A</Mission>
          <File_Class>TEST</File_Class>
          <File_Type>ESOVNG_IDF</File_Type>
          <Validity_Period>
              <Validity_Start>UTC=0000-00-00T00:00:00</Validity_Start>
              <Validity_Stop>UTC=9999-99-99T99:99:99</Validity_Stop>
          </Validity_Period>
          <File_Version>0001</File_Version>
          <Source>
                  <System>Manual</System>
                  <Creator>ESA/ESTEC</Creator>
                  <Creator_Version>2.4</Creator_Version>
                  <Creation_Date>UTC=2017-04-04T12:00:00</Creation_Date>
            </Source>
      </Fixed_Header>
      <Variable_Header></Variable_Header>
  </Earth_Explorer_Header>
  <Data_Block type="xml">
      <Idf>
          <Spacecraft>
              <Name>SENTINEL2A</Name>
              <Eecfi_Id>112</Eecfi_Id>
              <File_Extension>.S2</File_Extension>
              <Min_Orbits_Day>14.1</Min_Orbits_Day>
              <Max_Orbits_Day>14.5</Max_Orbits_Day>
```

File Header

Mission name (same as folder name)
EO CFI SW satellite ID enumeration

This min/max range is used to calculate the list of possible cycle lengths for a given repeat cycle in the “Use Orbit Parameters” Orbit panel

ESOVNG: Input Mission Files - Satellite Identification Files (II)



```
<Uses_DRS>true</Uses_DRS>
<DRS_Settings>
    <Longitude unit="deg">9.0</Longitude>
    <Min_Tangent_Height unit="m">100000.0</Min_Tangent_Height>
    <Inclusive_Mask_Points count="12">
        <Point>
            <Azimuth unit="deg">+005.000000</Azimuth>
            <Elevation unit="deg">-040.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+005.000000</Azimuth>
            <Elevation unit="deg">-033.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+016.000000</Azimuth>
            <Elevation unit="deg">-033.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+016.000000</Azimuth>
            <Elevation unit="deg">-011.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+026.000000</Azimuth>
            <Elevation unit="deg">-011.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+026.000000</Azimuth>
            <Elevation unit="deg">-000.500000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+184.000000</Azimuth>
            <Elevation unit="deg">-000.500000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+184.000000</Azimuth>
            <Elevation unit="deg">-010.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+200.000000</Azimuth>
            <Elevation unit="deg">-010.000000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+200.000000</Azimuth>
            <Elevation unit="deg">-086.500000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+030.000000</Azimuth>
            <Elevation unit="deg">-086.500000</Elevation>
        </Point>
        <Point>
            <Azimuth unit="deg">+030.000000</Azimuth>
            <Elevation unit="deg">-040.000000</Elevation>
        </Point>
    </Inclusive_Mask_Points>
    <Exclusive_Mask_Points count="0"></Exclusive_Mask_Points>
</DRS_Settings>
```

DRS links flag (true/false)

Longitude of GEO satellite
Minimum height over the Earth's Ellipsoid to be considered as 'occulted by Earth' constraint

DRS settings, enabled if the mission has communication links with a Data Relay Satellite

Satellite to DRS azimuth / elevation mask points

ESOVNG: Input Mission Files - Satellite Identification Files (III)

```
<Default_Settings>
    <Repeat_Cycle unit="day">10</Repeat_Cycle>
    <Cycle_Length unit="orbit">143</Cycle_Length>
    <ANX_Longitude unit="deg">1.000000</ANX_Longitude>
    <MLST unit="h">22.500000</MLST>
    <MLST_Drift unit="s/day">0.0</MLST_Drift>
    <Date>2017-01-02T00:00:00</Date>
    <Absolute_Reference_Orbit>8006</Absolute_Reference_Orbit>
</Default_Settings>
<TLE_Satellite_Data_Settings>
    <NORAD_Sat_Number>40697</NORAD_Sat_Number>
    <NORAD_Sat_Cat>SENTINEL-2A</NORAD_Sat_Cat>
    <International_Designator>15028A</International_Designator>
</TLE_Satellite_Data_Settings>
<Default_Orbit_Files>
    <OSF>S2A_OPER_MPL_ORBSCT_20150625T073255_99999999T999999_0006.EOF</OSF>
    <POF_ROF/>
    <TLE/>
</Default_Orbit_Files>
<List_of_Instruments count="2">
    <Instrument>
        <Name>ORBIT</Name>
        <Display_Name>Orbit</Display_Name>
        <Swath_Type>POINT</Swath_Type>
        <Appearance>
            <Colour>C0C0C0</Colour>
            <Draw>SOLID</Draw>
            <Fill>HOLLOW</Fill>
            <Opacity>100</Opacity>
        </Appearance>
    </Instrument>
    <Instrument>
        <Name>MSI</Name>
        <Display_Name>MSI</Display_Name>
        <Swath_Type>LINE</Swath_Type>
        <Apply_SZA>true</Apply_SZA>
        <Appearance>
            <Colour>993366</Colour>
            <Draw>SOLID</Draw>
            <Fill>SOLID</Fill>
            <Opacity>50</Opacity>
        </Appearance>
    </Instrument>
</List_of_Instruments>
        </Spacecraft>
    </Idf>
</Data_Block>
</Earth_Explorer_File>
```

Orbit Parameters loaded by default in 'Use Orbit Parameters' Orbit panel

TLE Settings

Orbit File to be loaded by default in Orbit panels 'Use Orbit Scenario File'/'Use Predicted/Restituted Orbit File' / 'Use TLE'
The file must be available in orbit_files/MISSION_NAME/ folder

List of instruments and style settings
ORBIT represents the satellite ground-track
Swath_Type can be either POINT or LINE

ESOVNG: Input Mission Files - Orbit Scenario Files

Orbit Scenario Files (OSF) contain orbit definition parameters

```
<Data_Block type="xml">
  <List_of_Orbit_Changes count="1">
    <Orbit_Change>
      <Orbit>
        <Absolute_Orbit>1</Absolute_Orbit>
        <Relative_Orbit>15</Relative_Orbit>
        <Cycle_Number>1</Cycle_Number>
        <Phase_Number>1</Phase_Number>
      </Orbit>
      <Cycle>
        <Repeat_Cycle unit="day">3</Repeat_Cycle>
        <Cycle_Length unit="orbit">43</Cycle_Length>
        <ANX_Longitude unit="deg">10.000000</ANX_Longitude>
        <MLST>22:30:00.000000</MLST>
        <MLST_Drift unit="s/day">0.000000</MLST_Drift>
        <MLST_Nonlinear_Drift>
          <Linear_Approx_Validity unit="orbit">99999</Linear_Approx_Validity>
          <Quadratic_Term unit="s/day^2">0.000000</Quadratic_Term>
          <Harmonics_Terms num="0"/>
        </MLST_Nonlinear_Drift>
      </Cycle>
      <Time_of_ANX>
        <TAI>TAI=2017-01-01T21:50:38.272398</TAI>
        <UTC>UTC=2017-01-01T21:50:01.272398</UTC>
        <UT1>UT1=2017-01-01T21:50:01.272398</UT1>
      </Time_of_ANX>
    </Orbit_Change>
  </List_of_Orbit_Changes>
</Data_Block>
```

Absolute orbit number

Orbit Parameters: Repeat Cycle, Cycle Length MLST ar ANX and MLST drift
ANX_Longitude is associated to Absolute orbit number

Date YYYY-MM-DD
The time within the day (HH:MM:SS.UUUUU) will be internally recalculated as function of MLST and ANX_Longitude

ESOVNG: Input Mission Files - Predicted Orbit Files

Predicted Orbit Files (POF) contain a list of Orbit State Vectors

```
<Data_Block type="xml">
  <List_of_OSVs count="4802">
    <OSV>
      <TAI>TAI=2020-08-03T01:14:51.407980</TAI>
      <UTC>UTC=2020-08-03T01:14:14.407980</UTC>
      <UT1>UT1=2020-08-03T01:14:14.193318</UT1>
      <Absolute_Orbit>+54704</Absolute_Orbit>
      <X unit="m">-6044774.282</X>
      <Y unit="m">+3719688.950</Y>
      <Z unit="m">-0000000.000</Z>
      <VX unit="m/s">+0422.584191</VX>
      <VY unit="m/s">+0659.887167</VY>
      <VZ unit="m/s">+7492.620884</VZ>
      <Quality>0000000000000</Quality>
    </OSV>
    <OSV>
      <TAI>TAI=2020-08-03T02:54:06.071897</TAI>
      <UTC>UTC=2020-08-03T02:53:29.071897</UTC>
      <UT1>UT1=2020-08-03T02:53:28.857287</UT1>
      <Absolute_Orbit>+54705</Absolute_Orbit>
      <X unit="m">-3920772.366</X>
      <Y unit="m">+5916495.226</Y>
      <Z unit="m">-0000000.000</Z>
      <VX unit="m/s">+0660.766528</VX>
      <VY unit="m/s">+0420.970965</VY>
      <VZ unit="m/s">+7492.474004</VZ>
      <Quality>0000000000000</Quality>
    </OSV>
```

- Predicted or Restituted Orbit Files are made available for ESA missions by ESOC FD or by PDGS
- Alternatively, the executable tool TLE2ORBPRE transforms a TLE orbit file to Predicted Orbit File format (see next slide for details)
  Link:
  https://eop-cfi.esa.int/index.php/applications/tools/command-line-tools-tle2orbpre

ESOVNG: Input Mission Files - TLE Files

Two-Line Elements Orbit Files (TLE) contain a set of orbit parameters

```
SENTINEL-3A
1 41335U 16011A   19014.20588057 -.00000018  00000-0  10680-4 0  9994
2 41335  98.6294  83.3935 0000875 102.9354 257.1924 14.26735247151492
```

Example of TLE file, saved as tle_s3a_14_JAN_2019.txt

- Two-Line Element (only for TLEs from CELESTRAK website, with mission name CRYOSAT 2, SMOS, SWARM A/B/C, SENTINEL-1A, SENTINEL-1B, SENTINEL-2A, SENTINEL-2B, SENTINEL-3A).

- For other satellites, TLE files cannot be loaded directly in SAMIEdit as type 'TLE' the executable tool TLE2ORBPRE transforms a TLE orbit file to Predicted Orbit File format. The output POF orbit file can then be ingested in SAMI as type 'POF'

Example of input configuration file

```
GENERIC
CHEOPS
44874
19092B
tle_20_DEC_2019_1.txt
30.0
```

Number of days to propagate

ESOVNG: Input Mission Files - Attitude

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- Attitude Definition File (ADF)
  - Nominal Attitude Law
    - ✓ Geocentric Pointing (=0)
    - ✓ Local Normal Pointing (=1)
    - ✓ Local Normal Pointing + Yaw Steering(=2)
    - ✓ Zero-Doppler + Yaw Steering(=3)

Enumeration values

```
<Data_Block type="xml">
  <Attitude_Definition>
  <Sat_Nominal_Att>
    <AOCS_Model>2</AOCS_Model>
  </Sat_Nominal_Att>
  <Sat_Att>
      <Angle_Model>
        <Angle_1>0.0</Angle_1>
        <Angle_2>0.0</Angle_2>
        <Angle_3>0.0</Angle_3>
      </Angle_Model>
  </Sat_Att>
  <Instr_Att>
     <None></None>
  </Instr_Att>
</Attitude_Definition>
```

Offset angles can be applied on top of nominal law

  - Mission Model Attitude Law
    - ✓ Specific attitude model to match on-board law
    - ✓ Details in EOCFI SW documentation (Pointing library)

Model values

```
<Attitude_Definition>
  <Sat_Nominal_Att>
    <Parameter_Model>
      <Model>5</Model>
      <List_of_Parameters count="1">
        <Parameter>-0.000072921158553</Parameter>
      </List_of_Parameters>
    </Parameter_Model>
  </Sat_Nominal_Att>
  <Sat_Att>
      <Angle_Model>
        <Angle_1 unit="deg">0</Angle_1>
        <Angle_2 unit="deg">0</Angle_2>
        <Angle_3 unit="deg">0</Angle_3>
      </Angle_Model>
  </Sat_Att>
  <Instr_Att>
      <Angle_Model>
        <Angle_1 unit="deg">0</Angle_1>
        <Angle_2 unit="deg">0</Angle_2>
        <Angle_3 unit="deg">0</Angle_3>
      </Angle_Model>
      <Offsets>
        <Offset_X unit="m">0</Offset_X>
        <Offset_Y unit="m">0</Offset_Y>
        <Offset_Z unit="m">0</Offset_Z>
      </Offsets>
  </Instr_Att>
</Attitude_Definition>
```

ADF only needed for DRS link enabled missions !

ESOVNG: Input Mission Files - Swath Definition (I)

EARTH OBSERVATION SYSTEM SUPPORT

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- Swath definition files consist of two parts:

Swath Definition Parameters

Attitude Definition Parameters

```
<Data_Block type="xml">
    <Swath>
      <Output_File_Description>OLCI</Output_File_Description>
      <Output_File_Type>MPL_SWTREF</Output_File_Type>
      <Swath_Type>open</Swath_Type>
      <Num_Swath_Records>1200</Num_Swath_Records>
      <Refraction>
        <Model>NO_REF</Model>
        <Freq unit="MHz">0000000000</Freq>
      </Refraction>
      <List_of_Swath_Points count="3">
        <Swath_Point>
          <Pointing_Geometry>
            <Azimuth unit="deg">+270.000000</Azimuth>
            <Elevation unit="deg">+068.295000</Elevation>
            <Altitude unit="m">+000000.000</Altitude>
          </Pointing_Geometry>
        </Swath_Point>
        <Swath_Point>
          <Pointing_Geometry>
            <Azimuth unit="deg">+090.000000</Azimuth>
            <Elevation unit="deg">+090.000000</Elevation>
            <Altitude unit="m">+000000.000</Altitude>
          </Pointing_Geometry>
        </Swath_Point>
        <Swath_Point>
          <Pointing_Geometry>
            <Azimuth unit="deg">+090.000000</Azimuth>
            <Elevation unit="deg">+043.135000</Elevation>
            <Altitude unit="m">+000000.000</Altitude>
          </Pointing_Geometry>
        </Swath_Point>
      </List_of_Swath_Points>
      <Sat_Nominal_Att>
        <AOCS_Model>2</AOCS_Model>
      </Sat_Nominal_Att>
      <Sat_Att>
        <None></None>
      </Sat_Att>
      <Instr_Att>
        <None></None>
      </Instr_Att>
    </Swath>
</Data_Block>
```

ESOVNG: Input Mission Files - Swath Definition (II)

EARTH OBSERVATION SYSTEM SUPPORT

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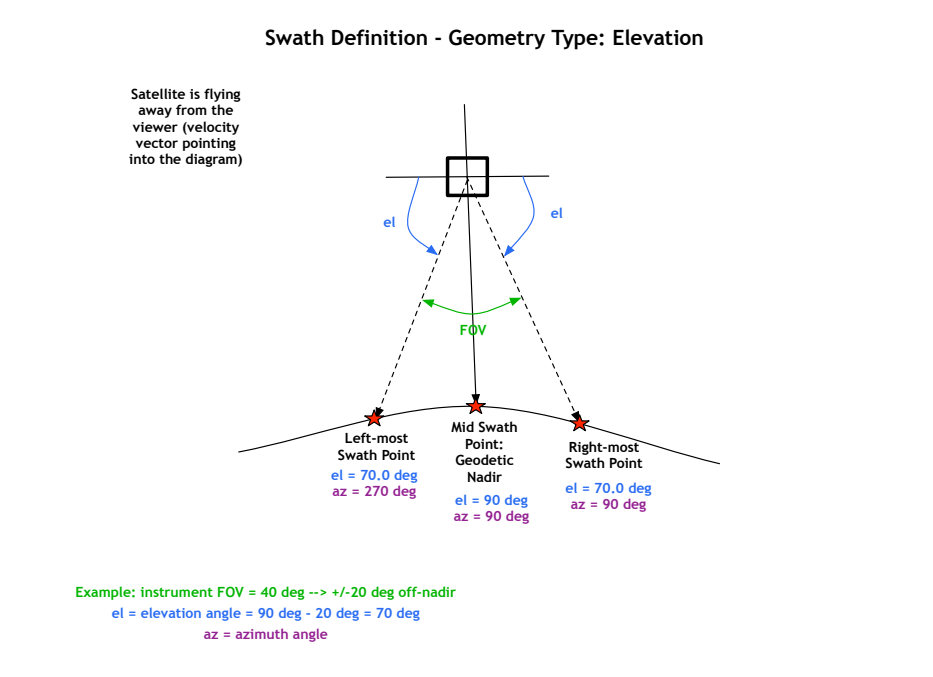
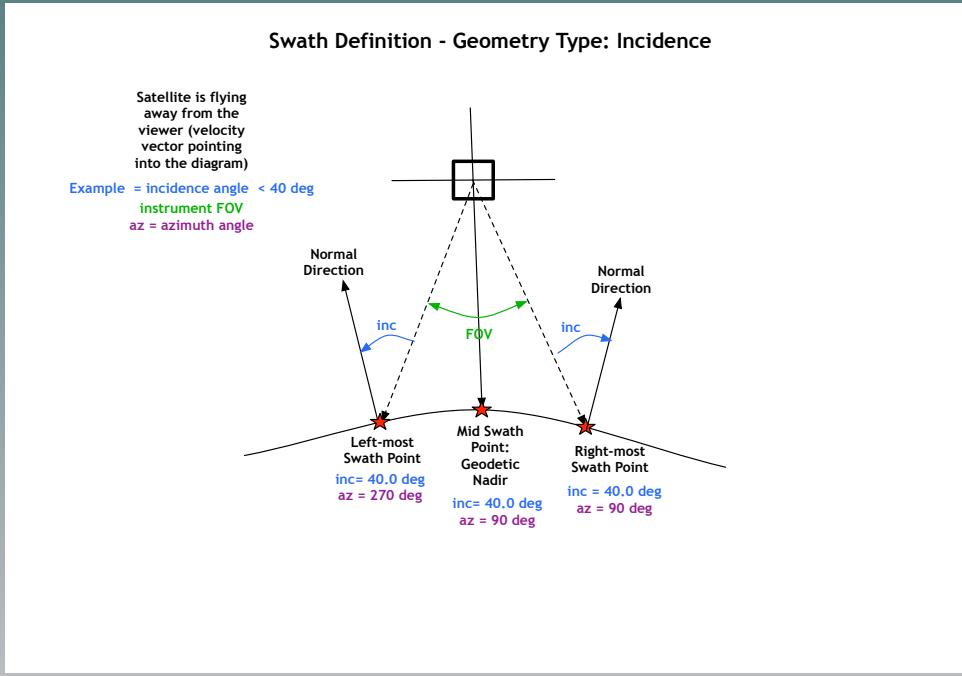
- Instrument Swath can be defined based on:
  - ✓ Elevation Angle
  - ✓ Incidence Angle
  - ✓ Swath Width




```
<List_of_Swath_Points count="3">
  <Swath_Point>
    <Pointing_Geometry>
      <Azimuth unit="deg">+270.000000</Azimuth>
      <Elevation unit="deg">+070.000000</Elevation>
      <Altitude unit="m">+000000.000</Altitude>
    </Pointing_Geometry>
  </Swath_Point>
  <Swath_Point>
    <Pointing_Geometry>
      <Azimuth unit="deg">+090.000000</Azimuth>
      <Elevation unit="deg">+090.000000</Elevation>
      <Altitude unit="m">+000000.000</Altitude>
    </Pointing_Geometry>
  </Swath_Point>
  <Swath_Point>
    <Pointing_Geometry>
      <Azimuth unit="deg">+090.000000</Azimuth>
      <Elevation unit="deg">+070.000000</Elevation>
      <Altitude unit="m">+000000.000</Altitude>
    </Pointing_Geometry>
  </Swath_Point>
</List_of_Swath_Points>
```

ESOVNG: Input Mission Files - Swath Definition (III)

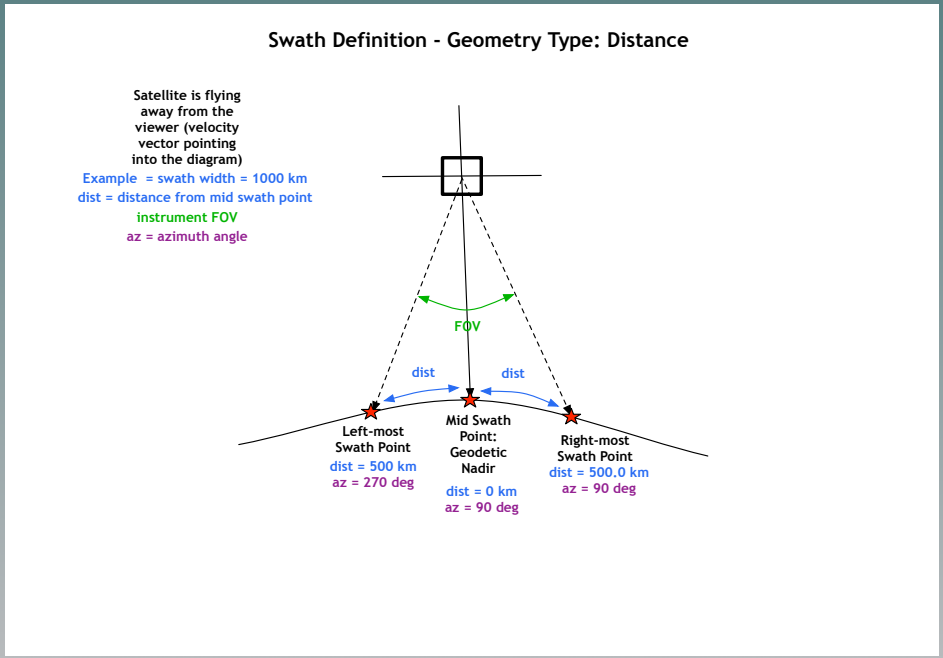
- Instrument Swath can be defined based on:
  - ✓ Elevation Angle
  - ✓ Incidence Angle
  - ✓ Swath Width




```
<List_of_Swath_Points count="3">
<Swath_Point>
  <Incidence_Angle_Geometry>
    <Azimuth unit="deg">+270.000000</Azimuth>
    <Incidence_Angle unit="deg">+040.000000</Incidence_Angle>
    <Altitude unit="m">000000.000</Altitude>
   </Incidence_Angle_Geometry>
</Swath_Point>
<Swath_Point>
  <Incidence_Angle_Geometry>
    <Azimuth unit="deg">+090.000000</Azimuth>
    <Incidence_Angle unit="deg">+040.000000</Incidence_Angle>
    <Altitude unit="m">000000.000</Altitude>
  </Incidence_Angle_Geometry>
</Swath_Point>
<Swath_Point>
  <Incidence_Angle_Geometry>
    <Azimuth unit="deg">+090.000000</Azimuth>
    <Incidence_Angle unit="deg">+040.000000</Incidence_Angle>
    <Altitude unit="m">000000.000</Altitude>
  </Incidence_Angle_Geometry>
</Swath_Point>
</List_of_Swath_Points>
```

ESOVNG: Input Mission Files - Swath Definition (IV)

- Instrument Swath can be defined based on:
  - ✓ Elevation Angle
  - ✓ Incidence Angle
  - ✓ Swath Width




```
<List_of_Swath_Points count="3">
  <Swath_Point>
    <Distance_Geometry>
      <Azimuth unit="deg">+270.000000</Azimuth>
      <Elevation unit="deg">+090.000000</Elevation>
      <Altitude unit="m">000000.000</Altitude>
      <Distance unit="m">500000.000</Distance>
    </Distance_Geometry>
  </Swath_Point>
  <Swath_Point>
    <Distance_Geometry>
      <Azimuth unit="deg">+090.000000</Azimuth>
      <Elevation unit="deg">+090.000000</Elevation>
      <Altitude unit="m">000000.000</Altitude>
      <Distance unit="m">000000.000</Distance>
    </Distance_Geometry>
  </Swath_Point>
  <Swath_Point>
    <Distance_Geometry>
      <Azimuth unit="deg">+090.000000</Azimuth>
      <Elevation unit="deg">+090.000000</Elevation>
      <Altitude unit="m">000000.000</Altitude>
      <Distance unit="m">500000.000</Distance>
    </Distance_Geometry>
  </Swath_Point>
</List_of_Swath_Points>
```

ESOVNG: Mission Input Files - User Support

EARTH OBSERVATION SYSTEM SUPPORT

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- ESOVNG User Support contact e-mail

  esov@eopp.esa.int

- For further details on the application interface and available features, please have a look to the ESOVNG User Manual

  https://eop-cfi.esa.int/Repo/PUBLIC/DOCUMENTATION/APPLICATIONS/ESOVNG/esov-sum-2.6.4.pdf